LAVA BEDS NATIONAL MONUMENT
GEOLOGIC RESOURCES MANAGEMENT ISSUES
SCOPING SUMMARY

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September 20, 2004

Executive Summary

A Geologic Resources Evaluation scoping meeting for Lava Beds National Monument as held in Ashland, Oregon, March 4, 2004. The scoping meeting participants identified the following as the most significant geologic resources management issues.

1. There is a need to identify and protect caves and cave resources.

2. Wind carrying sand and gravel particles is eroding the petroglyphs at Petroglyph Point. An evaluation of methods to protect the petroglyphs is needed.

3. There is a need to study and define the groundwater supply and the amount of drawdown.

4. Rockfalls and collapse of lava tubes from both natural sources (freezing and thawing) and from human impacts (vehicular traffic) must be evaluated.

5. The reclamation of sand and gravel borrow sites should be evaluated.

Introduction

The National Park Service held a Geologic Resources Evaluation scoping meeting for Lava Beds National Monument (LABE) in Ashland, Oregon, Thursday morning, March 4, 2004. The purpose of the meeting was to discuss the status of geologic mapping in the park, the associated bibliography, and the geologic issues in the park. The products to be derived from the scoping meeting are: (1) Digitized geologic maps covering LABE; (2) An updated and verified bibliography; (3) A scoping summary (this report); and (4) A Geologic Resources Evaluation Report which brings together all of these products.

Lava Beds National Monument was established on November 21, 1925, by Presidential Proclamation No. 1755, and placed under the jurisdiction of the Department of Agriculture, U.S. Forest Service. It was transferred to the Department of the Interior by Executive Order No.6166 on June 10, 1933. Public Law 92-493, dated October 13, 1972, established 28,460 acres as wilderness. Total area of the monument is about 46,560 acres.

Lava Beds NM is covered by four topographic quadrangle maps: The Panhandle, Captain Jacks Stronghold, Schonchin Butte, and Caldwell Butte. In addition, there are 16 other quads of interest that lie outside the park: Newell, Tulelake, Hatfield, and Lower Klamath Lake to the north; Copic and Perez to the east; Mount Dome and Bonita Butte to the west; and, Kephart, West of Kephart, Medicine Lake, Little Glass Mountain, Snag Hill, Porcupine Butte, Border Mountain, and Hollenbeck to the south. LABE is on the Alturas Sheet of the Geologic Map of California, scale 1:250,000.

U.S. Geological Survey Water-Supply Paper 1491 (1960) covers an area west of the park at a scale of 1:62,500. Julie Donnelly-Nolan and Duane Champion have mapped the park at a scale of 1:24,000 released by the U.S. Geological Survey as Miscellaneous Investigations Map I-1804.

This 1987 map was digitized by the park but needs metadata and a review for full attribution capturing. Julie Donnelly-Nolan is preparing a geologic map of the Medicine Lake Volcanic area at a scale of 1:50,000. It may be available in 2005 in both paper and digital formats. Jim Smith with the USGS in Reston is working in areas covered by the Alturas and Weed sheets.

An issue arose concerning the identification of caves (lava tubes) and cave openings in the park on maps, especially the geologic map in preparation. Although the park has identified and published many lava tube openings for the public, others (especially class 3 and 4) are considered sensitive and the park prefers to keep them proprietary. An argument can be made that lava tubes as geological features are identifiable on the map and, when combined with topographic maps, cave entrances can be located. The USGS has an agreement with the National Cave and Karst Institute that it will not publish cave entrance locations on any new topographical maps without the written consent of resource managers. This agreement includes lava tubes. However, the topographic base maps that are used for new geologic mapping were in most cases published 20 or more years ago, before this agreement was in place and hence these openings are already in the public domain. It was agreed that no new openings would be mapped and that the park can choose to make a separate GIS layer of the opening for park use only. This will give the park the option to remove the lava tubes from the geologic map and note that the map has been revised the NPS.

Physiography

Lava Beds National Monument lies in the Modoc Plateau physiographic province which covers over 4,800 square miles (12,400 km^2) in northeastern California and south-central Oregon (McKee, *et al.*, 1983). The plateau is a volcanic platform generally ranging in elevations between 4,000 to 6,000 feet. It is bounded on the north and east by the Basin and Range province, on the west by the Cascade Range, and on the south by the Sierra Nevada. Indeed, the Modoc Plateau is often not distinguished as a separate province, but as a transition between the Cascades and the Basin and Range. Much of the plateau is broken by block faulting characteristic of the Basin and Range.

LABE lies on the northern flank of Medicine Lake Volcano. The volcano is a Pleistocene to Holocene shield volcano located about 30 miles northeast of Mt. Shasta. The eruptive area of the volcano covers over 900 mi^2. The highest point on the caldera rim above Medicine Lake is 7,913 feet. Medicine Lake lies in the 4.5 x 7.5-mile caldera at an elevation of 6,676 feet (Donnelly-Nolan, 1987). There is evidence of glaciation (glacial striations, polish and erratics) at the higher elevations of the volcano.

Geologic History and Stratigraphy

The oldest rocks of the Modoc Plateau are lava flows and volcanic debris of the Cedarville series, best exposed in the Warner Mountains which forms the eastern boundary. This has been dated as late Oligocene or early Miocene. Late Miocene basin and range faulting disrupted many of the established drainages resulting in the deposition of lake sediments as well as mudflows,

ash, diatomite, and volcanics. Since the Miocene, there has been an extensive outpouring of mostly andesitic and basaltic lavas (Norris and Web, 1976).

In Lava Beds NM, the lava flows range in age from Pleistocene to Holocene. The youngest flow is basaltic to andesitic in composition (the Callahan flow) and has been dated by carbon-14 at about 1100 years. These lavas erupted from vents outside the southwestern corner of the monument. Overlying this lava flow and much of the monument are deposits of pumice from still younger eruptions that took place high on Medicine Lake volcano. The youngest lava entirely within the monument is the 3,000-year old Black Crater-Ross Chimneys flow, erupted from a line of spatter vents. Two other post-glacial lava flows are the Devils Homestead and Valentine Cave flows which are present in the western and southern parts of the monument, respectively. However, the largest lava flow erupted from Mammoth Crater and other nearby cones and craters in the late Pleistocene, and covers about 70% of the monument. This flow is host to most of the lava tube caves in the park. Mammoth Crater lies at the extreme southern end of the park. Interbedded with the lava flows are lacustrine deposits, glacial deposits, and talus, all of Pleistocene to Holocene age.

Significant Geologic Resource Management Issues in Lassen Volcanic National Park

1. Cave resource protection.

Lava Beds has one of the better cave programs in the Park Service and has maintained a good working relationship with the Cave Research Foundation. The protection and preservation of the lava tubes is of primary importance to the park. There are 502 known cave locations. There is a GIS theme layer showing the known cave locations, but this data is sensitive and proprietary to the park. Although on the one hand there is a desire to allow visitors to enter and explore many of the lava tubes, there is an equal desire and need to protect these tubes from vandalism and from the impacts of visitor use. Therefore, many of the lava tube openings will not be revealed to visitors.

Tubes can be easily damaged, features have been broken or removed, and there has been deterioration of ice in some of the caves resulting from human use. The park has a Cave Management Plan from 1990 and a new, updated draft is pending approval. Those tubes that the park has made available for visitor use, the park would like to develop protocols for visitor use including group tours. At present visitors can enter a cave without contacting park staff. Questions to consider are: should there be log book or some method established by which the park can track and potentially limit visitor use? Should signs that identify cave openings be removed? Due to impacts from vehicular traffic, perhaps the Cave Loop Road should be only a foot trail.

One idea is to establish sensors in cave entrances to detect visitor entry and movements. At present 14 species of bats use the lava tubes as habitat. There is a need for additional bat gates to protect bat habitat, especially colonies of the Townsend big-eared bat. The park is presently in the process of obtaining sensors to monitor bat maternities and roosting areas. The park is also developing a project with Oregon State University to core the ice in some of the ice caves. Janet

Sowers with the Cave Research Foundation has performed cave inventories and believes that more detailed inventories are needed.

2. Wind erosion at Petroglyph Point.

Petroglyphs, figures carved into rock by the Klamath and Modoc Indian tribes, are visible on the cliff face at the Petroglyph Section, a detached area of the park northeast of the northeast entrance to the park. However, blasting by wind carrying sand and gravel particles is eroding the features at Petroglyph Point. The park has installed a metal shield to protect the rock art, but removing or re-routing the access road may be a more permanent solution. This has not been a solution favored by the local residents.

3. Groundwater supply

Due to the high porosity of the lava, there is no permanent surface water in the park. Also, since there are no distinct aquifers in the area, there is uncertainty about the source, quantity, quality, and movement of groundwater in the park. There is one water well at park headquarters, about 700 feet deep. The U.S. Geological Survey is monitoring groundwater at five wells, four in the park and one outside. The State of California is also conducting groundwater studies in the Klamath Basin. There appears to be some drawdown of groundwater from agricultural use. There is a need to look at the groundwater supply. The park has contacted the NPS Water Resources Division to help evaluate the status of the groundwater.

4. Rockfalls

Rockfalls occur on some of the park roads, mostly related to freezing and thawing. Rockfalls also occur within some of the lava tubes. In both instances, these are hazardous to visitor as well as to park staff health and safety. As part of his effort to map the caves, Aaron Waters with the USGS noted many areas of rockfalls (Waters, *et al*., 1990). These areas are of concern especially if there is earthquake activity. Although, there is not much seismic activity in the area, the are many young faults and there is potential for future eruptions. A recent earthquake near Klamath Falls, OR, had a magnitude in excess of 6. Similar quakes could occur near the monument.

A potentially greater problem is the possibility of lava tube collapse from their proximity to the roads. Some roads have been built over lava tubes creating the potential for collapse of the road into the tube. A program is under way to repave some of the roads in LABE. As part of this process, the park has initiated a study of the subsurface voids by a contractor through the Federal Highway Administration. The study could establish weigh limits for vehicles using the park roads.

There is also an issue of coring to better define voids. The park is generally opposed to such a disruptive and potentially damaging activity. There are other less invasive methods to detect subsurface voids such as magnetometer survey as has been done by the USGS at Hawaii

Volcanoes National Park. There is also a plan to pave about 2.5 miles of the Medicine Lake road at the south end of the park.

5. Reclamation sites

There are 22 sand and gravel extraction sites (pits) in the park totaling about 40 acres. These sites are being systematically reclaimed. There is a draft rehabilitation plan available for these sites. Some are already revegetating and reclaiming these areas may create a greater disturbance than allowing them to revegatate naturally. There is an interest by Julie Donnelly-Nolan to keep portions of some of these sites open and available for study and interpretation of the geology at a particular site. For example, a

6. Other issues

Seismic Activity: There has been seismic activity at the park. There is a USGS seismic station at park headquarters. It is suggested that the station be moved to the new visitors center and used for interpretation.

Volcanic Activity: The latest lava flow in the park has been dated at about 1,100 years ago. The most recent eruption of the Medicine Lake volcano, the largest volcano in the Cascades in terms of volume of material, was about 900 years ago. At least 17 eruptions of the volcano have occurred in the last 12,000 years, averaging about one to two eruptions per century. However, the eruptions are very episodic (Donnelly-Nolan, 1990). Although an eruption is not imminent, there is a need for a volcanic hazards assessment for LABE. Julie Donnelly-Nolan will prepare a volcanic hazard assessment for the Medicine Lake volcano within the next couple of years, although it will not be specific to LABE.

Paleontologic Resources: Fossils have been found in some of the caves, including camel, jaguar, and other vertebrates. These have been listed in the cave inventories, but not yet dated. There has been some vandalism and theft of these fossils.

Geothermal Exploration and Development: The Glass Mountain Known Geothermal Resource Area (KGRA) is located adjacent to LABE to the south. The KGRA allows the Bureau of Land Management to conduct competitive lease sales for geothermal exploration. In the past there has been exploratory drilling for geothermal resources in the Medicine Lake area, up to the southern boundary of the park. Although, it is unlikely that any wells will be drilled in the park, outside activity could have an impact on LABE. There could be a drawdown of the groundwater table in addition to the vibration and disturbance caused by the drilling rigs and support activities. The greatest impact, however could be visual, if a geothermal field were to be developed, including steam plumes and gases from a power plant.

Desert Crusts: The desert crusts have been impacted by previous livestock grazing in the park. The last grazing occurred in 1975. There is a need to locate and inventory the

occurrences of desert crusts and develop a map. This may be done in conjunction with future soils mapping.

Interpretation: Julie Donnelly-Nolan would like to be involved in developing interpretative signs explaining aspects of the park geology. She is available as a resource for the park and would like to be consulted prior to designing geology exhibits for the new visitor's center. She also is interested in helping with seasonal training in 2004. A proposal she introduced consists of work with the interpretative staff to develop a loose-leaf "geology notebook" of photographs and accompanying descriptions of geological features which could easily be added to and past on to succeeding park staff. Park staff could take photos and send it to Julie for comments and a caption. The photo and the appropriate caption would then be added to the notebook. This notebook could be useful to both natural resource and interpretative staffs.

There is interest in having a Geoscientist-in-the-Park (GIP) work with Julie and park staff. Daniel Sarr, Klamath Network monitoring coordinator, is interested in Julie presenting her work to Southern Oregon University faculty and Klamath Network staff to help build partnerships. Also, Julie has had a number of discussions with Volcano Video Productions regarding the possibility of making a new video for Lava Beds, documenting the status of Lava Beds at a particular point in time. Some limited funding is available.

Scoping Meeting Participants

Tim Connors	Geologist	NPS, Geologic Resources Division
Sid Covington	Geologist	NPS, Geologic Resources Division
Anne Poole	Geologist	NPS, Geologic Resources Division
Ron Kerbo	Cave Specialist	NPS, Geologic Resources Division
Pete Biggam	Soil Scientist	NPS, Natural Resources Information Div.
Chris Currens	Aquatic Biologist	USGS, Biological Resources Division
Marsha Davis	Geologist	NPS, Columbia Cascades Support Office
Dave Larsen	Chief, Natural Resources	Lava Beds National Monument
Julie Donnelly-Nolan	Geologist	USGS, Geologic Division
Daniel Sarr	Network Coordinator	NPS, Klamath Network
Bob Truitt	Data Manager	NPS, Klamath Network
Hanna Waterstat	Data Miner	NPS, Klamath Network

References

Donnelly-Nolan, Julie M., 1990, Geology of the Medicine Lake volcano, Northern California, Cascade Range, *in* Geothermal Resources Council Transactions, v.14, Part II, p.1395.

Donnelly-Nolan, Julie M., 1987, Medicine Lake Volcano and Lava Beds National Monument, California, *in* Cordilleran Section of the Geological Society of America (M.L. Hill, ed.), in the collection Decade of North American Geology Project series, Centennial field guide, Geological Society of America, v.1, p.289-294.

Donnelly-Nolan, Julie M., and Champion, Duane E., 1987, Geologic map of Lava Beds National Monument, Northern California, U.S. Geological Survey Miscellaneous Investigations Map I-1804, 1:24,000.

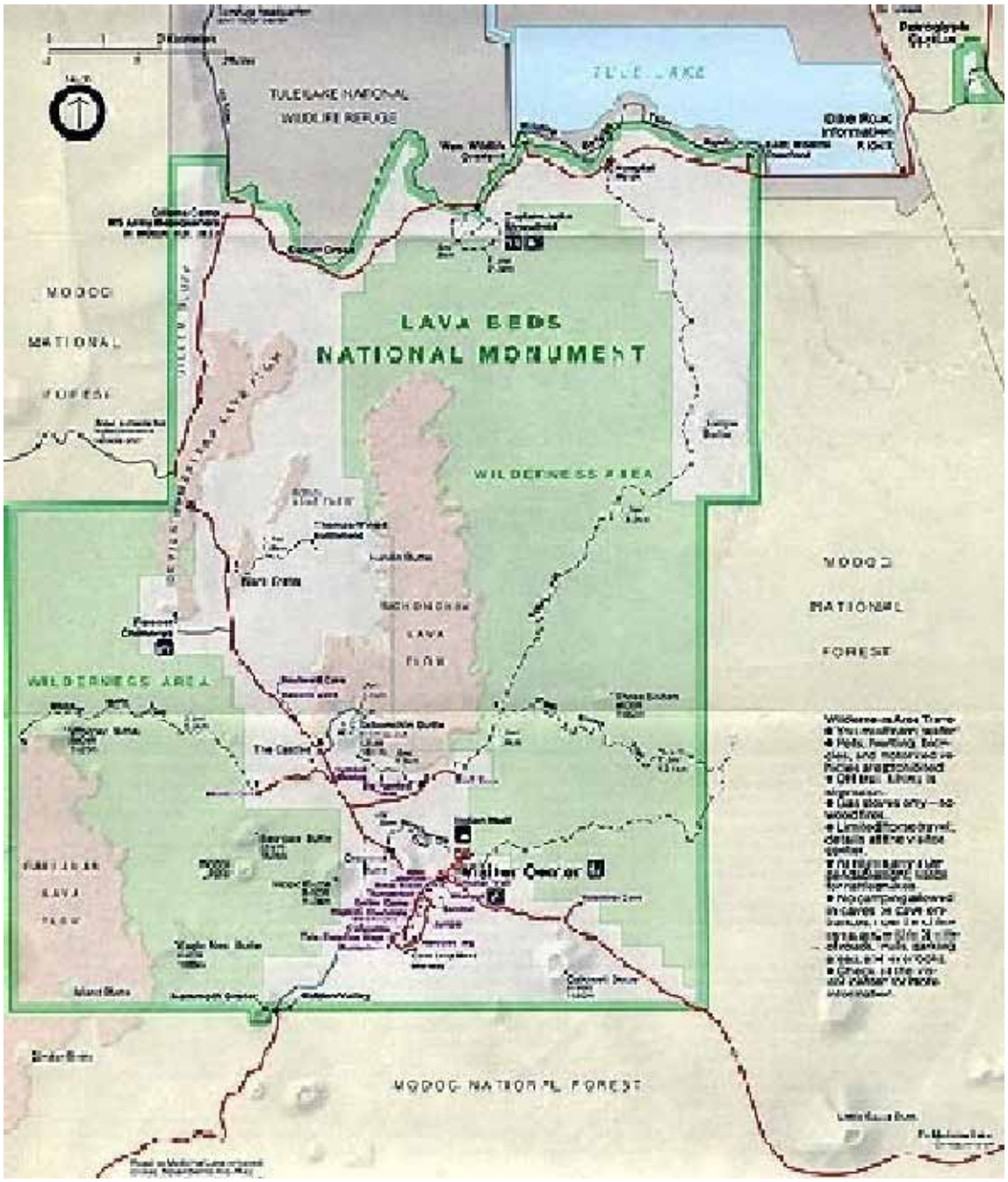
Gay, T.E., and Aune, Q.A., 1958, Geologic map of California, Alturas sheet, California Division of Mines and Geology, scale 1:250,000.

McKee, Edwin H., Duffield, Wendell A., and Stern, Robert J., 1983, Late Miocene and early Pliocene basaltic rocks and their implications for crustal structure, northeastern California and south-central Oregon, *Geological Society of America Bulletin*, v.94, no.2 (Feb.), p.292-304.

Norris, Robert M., and Webb, Robert W., 1976, *Geology of California*, John Wiley & Sons, N.Y., p.84-89.

Waters, Aaron C., Donnelly-Nolan, Julie M., and Rogers, Bruce W., 1990, Selected caves and lava-tube systems in and near Lava Beds National Monument, U.S. Geological Survey Bulletin 1673, 102p., Plates 1-6 (in back pocket).

Wood, P.R., 1960, Geology and ground-water features of the Butte Valley region, Siskiyou County, California, U.S. Geological Survey Water-Supply Paper 1491, scale 1:62,500.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